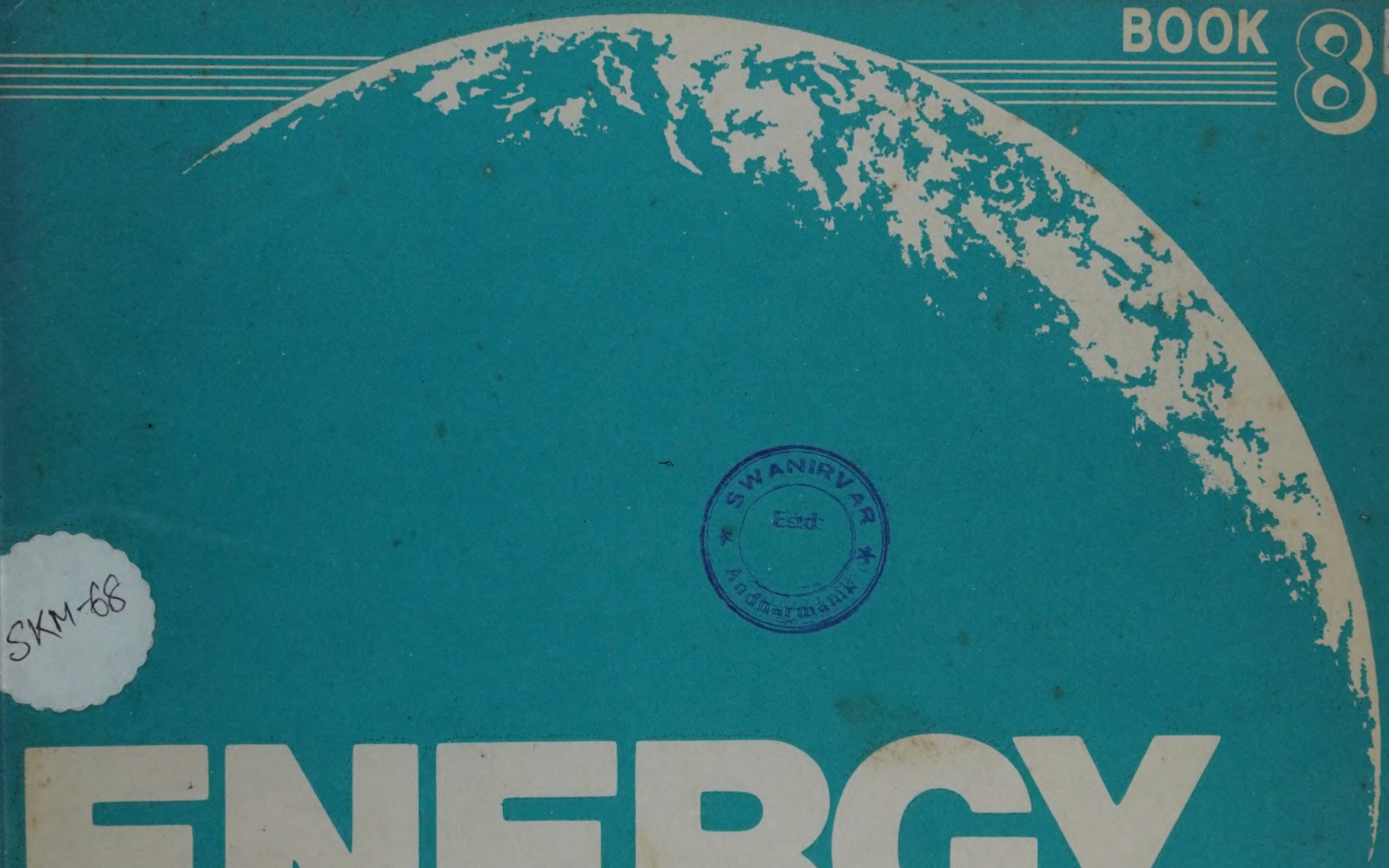
BOOK 8

EVS



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ENERGY

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In a poor country, in which environment is often the sole source of sustenance, energy generation cannot be allowed to become an excuse for environmental destruction and human impoverishment. If thermal power stations are a major cause of land destruction by mining and heavy atmospheric pollution, hydroelectric power stations have become a major cause of forest destruction, adverse changes in riverine ecology and massive displacement of human communities. The environmental costs of nuclear power stations are not even fully understood.

—Centre for Science and Environment,
(The State of India's Environment 1984-85)

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ENERGY

Every morning when you get ready to got to school, you put your books and papers into a bag, and lift it up. What is it that enables you to lift and carry your school bag? It is energy. Energy is the force that enables us to work. Without energy there would be no movement, no heat or light—no cooking, no transport, no agriculture, no industry.

Muscle energy

Human beings and animals such as donkeys, bullocks, camels and horses, use the power of their own muscles to carry or pull weights. In a village, muscle energy provides the force for many daily activities. For example, muscle energy is required for drawing water from a well or for pounding grain. Think of all the different ways in which you use muscle energy each day. This is the most elementary form of energy, and it is fuelled by the food human beings and animals eat.

Fuel from plants and animals

Green plants, which use the energy of the sun to make food, are rich storehouses of energy. When a dry plant, or a part of it, is burned, energy is released in the form of heat and light. The warmth and brightness of a fire of burning logs comes from the energy stored in the trees from which the logs were cut. In traditional *chulas* (stoves) dry twigs and the branches of shrubs and trees are burned as fuel.

Dry leaves which have fallen from trees, and the residue of agricultural crops after harvesting, such as stalks and chaff, are also used as fuel for chulas. The food which cattle eat contains a lot of plant material. Some of this cannot be digested and is excreted as dung. In many parts of India cattle dung is made into slabs of dry dung cakes or "uppale", which too are used as fuel in chulas.

Firewood, agricultural residues and animal dung are together called *traditional fuels*. Poor people depend almost completely on the traditional fuels, which old people, women and children gather from the fields and forest. In our villages, the traditional fuels and muscle energy make up the major share of energy. In India as a whole—including the cities, towns and villages—the traditional fuels account for nearly 45% of all the fuel used for all purposes.

Cooking requires an overwhelming proportion of energy in a village. Each household has to spend an enormous amount of time gathering fuel for the chula. In deforested areas where dry twigs and branches cannot be found near the village, women have to walk many kilometers in search of firewood, sometimes spending one or two days each week on this chore alone. Because of this many villagers are using much less energy than they would like to use.

The traditional chula is a very inefficient way of using energy. Ninety percent of the energy in the fuel is lost into the atmosphere; only 10% goes to actually heat the cooking pot.

Recently, some new chula designs have been developed. Although these may be more convenient to use, they have not really helped to save a lot of fuel. And because these stoves are more difficult to make, and cost more than the simple mud chula, which anyone can build, the new designs have still to become popular.

Firewood scarcity

A tree will produce leaves, twigs and branches as long as it is alive. Even if a small branch is cut, the tree will grow other branches. So, the energy from a living tree can be used again and again. Trees and other living plants have the capacity to renew themselves. All the traditional fuels are *renewable* to a certain extent. A limited amount of fuel can be collected from a forest and the supply need not be exhausted. But when the extraction of firewood exceeds the capacity of the forest to renew itself, or when the trees themselves are cut and no new trees are planted, firewood will become more and more scarce. Soon the forest will turn to scrubland if the process continues, and eventually it will become a wasteland.

India already faces a severe cooking energy crisis in the villages, because of the scarcity of firewood. This has been made worse in recent times because the poor people living in towns and cities and small industries also use firewood. Traders buy up firewood that villagers have collected and sell it at a profit to those who can pay a higher price. Firewood is transported to the city as headloads, and in trucks and trains. Roadside dhabas and tea stalls, bakeries, small scale industries and crematoria are major consumers of firewood. Roughly one third of the firewood used in India is in the cities.

In the villages the scarcity of firewood leads to burning more agricultural residues and animal dung. But crop stalks and dung are very rich manure. Burning them as fuel means depriving the fields of this valuable natural fertilizer.

Fuels from underground

Unlike the traditional fuels, the *modern fuels* such as coal, oil and natural gas, cannot be collected by individuals. This is because they have to be extracted from the earth and processed before they can be used. These fuels are derived from the fossil deposits of trees which have turned to crude coal, oil and natural gas over millions of centuries deep down below the surface of the earth. So, coal, oil and natural gas are called *fossil fuels*. By refining crude oil we get kefosene, diesel and petroleum (or petrol.) Modern life depends heavily on the fossil fuels to run machines..

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Think of a normal day in your life. Do you use less muscle energy than a person in your situation would have 100 years ago ? What has taken the place of the muscle energy ? If you take a bus to school instead of walking or riding a bicycle, muscle energy has been replaced by fossil fuel energy, the diesel which enables the bus to go. Modern transport depends on oil for fuel. Modern agriculture too uses diesel for mechanised pump sets and tractors.

Both kerosene and natural gas are used as cooking fuels. Kerosene and gas stoves are more efficient than firewood chulas, but the stoves are much more expensive than a chula. Natural gas which is supplied in cylinders to consumers is a relatively cheap fuel, but the supply is only available in the bigger towns and cities.

The fossil fuels are not renewable. How long the fuel deposits last depends on how much we extract. It has been calculated that India's coal deposits will last for 100 years, and that its known reserves of oil and natural gas for less than 35 years. India imports some of the oil that the country needs from West Asia and we are trying to locate new sources of oil under the sea.

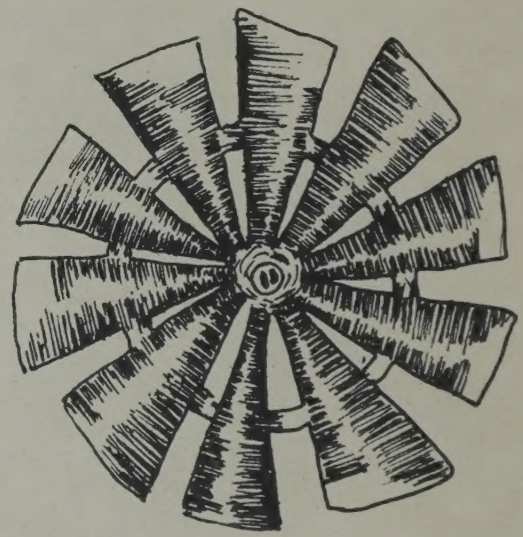
All the fossil fuels contain carbon : coal has the most, oil less and natural gas the least. When they are burned the carbon forms a noxious gas which pollutes the air. Much of the air pollution in a city is due to the diesel and petrol used to fuel motor transport.

Electricity

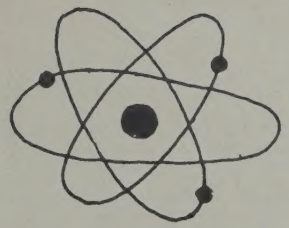
Electric power is a special form of energy. It has to be produced by using other energy sources. For instance, in thermal power stations coal is burned as fuel to produce electricity. About half of India's electric supply comes from *thermal* or coal energy converted to electricity.

Water can also be used to generate electricity by damming a river and using the force of the waterfall that is created to turn turbines. This is called *hydro-electricity* and it is *renewable,* so long as there is sufficient water in the river. It is also a clean source of energy. Unlike thermal power hydroelectricity does not pollute the air. But there are other difficulties especially with very large dams. When a river is dammed, and a huge reservoir created behind the river, a vast area is submerged under the water. This means that people living in the area have to move elswhere. The Tehri dam in Uttar Pradesh for instance requires the submersion of Tehri town and many villages. This also affects the ecology of an area. Can you think how ?

Usually, the electricity generated in a big dam project is intended for industries and cities. The people who live in the villages around the dam site do not often benefit from the increase in electricity. Could you do without electricity in your daily life ? Think what your day would be like.



Nuclear

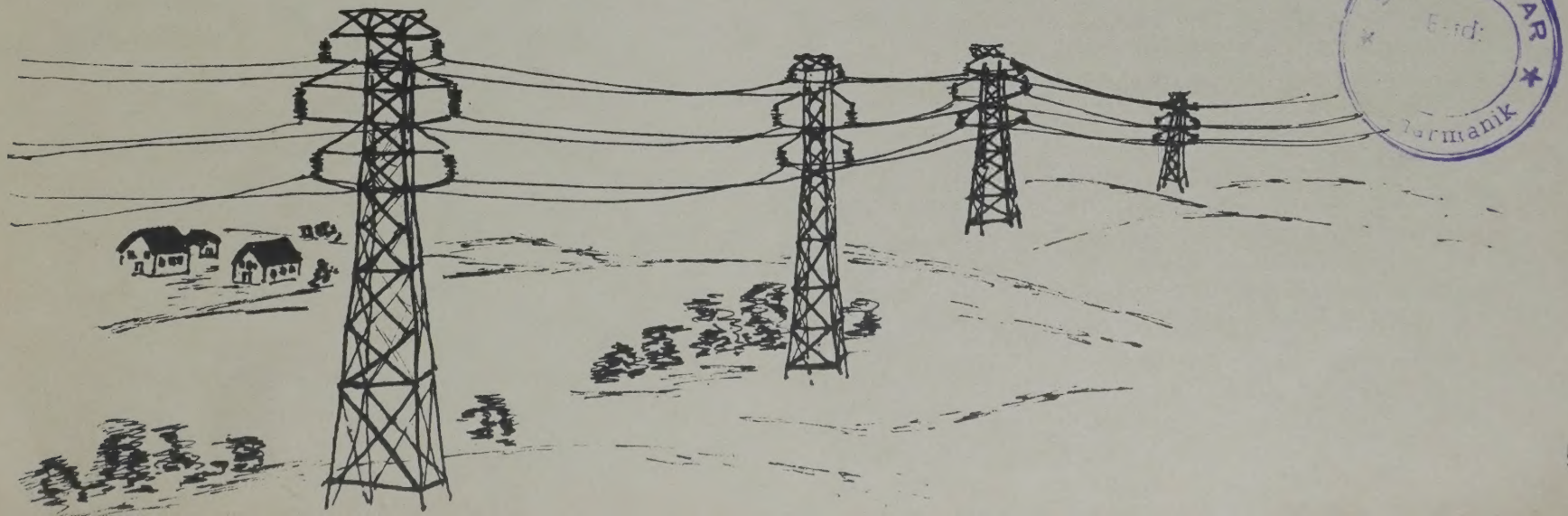


The most recent form of energy is derived from nuclear fuel. Thorium and uranium, which are radioactive elements, are mined from the earth and they are used to generate electricity through a process of nuclear reaction in atomic power stations. At present, the amount of nuclear electricity produced in India is negligible, but the government plans a big increase, because nuclear fuel is expected to be cheaper and non-polluting. But there is a lot of controversy about this. There are two problems with nuclear electricity. One is the danger of radioactive materials accidently leaking out of a nuclear power station, as happened in Chernobyl in the USSR. The second problem is the difficulty of disposing off radioactive waste materials safely. The question is, should we risk using nuclear fuels, which have many dangerous side effects ?

Who uses modern fuels ?

World energy consumption is very unbalanced. All the fuel used by the countries of Africa, Asia and Latin America for all purposes is only a little more than what the industrialised countries of Europe and North America use just to move their cars. Three quarters of the world's people use only 15% of the total energy derived from coal, oil, natural gas, hydro and nuclear power.

The same kind of imbalance exists within India itself. During that last 35 years the consumption of coal, oil and electricity in India has grown at a faster rate than the economy as a whole. But very little of this increased energy use has reached the villages where 70% of the population lives. There are two main reasons for this. The villagers are usually too poor to buy fuels. Secondly, the cost of distributing modern fuels to the rural areas is usually higher than to the towns. As a result, the rural poor consume only a minute fraction of India's coal, oil and electricity.



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Alternative energy sources

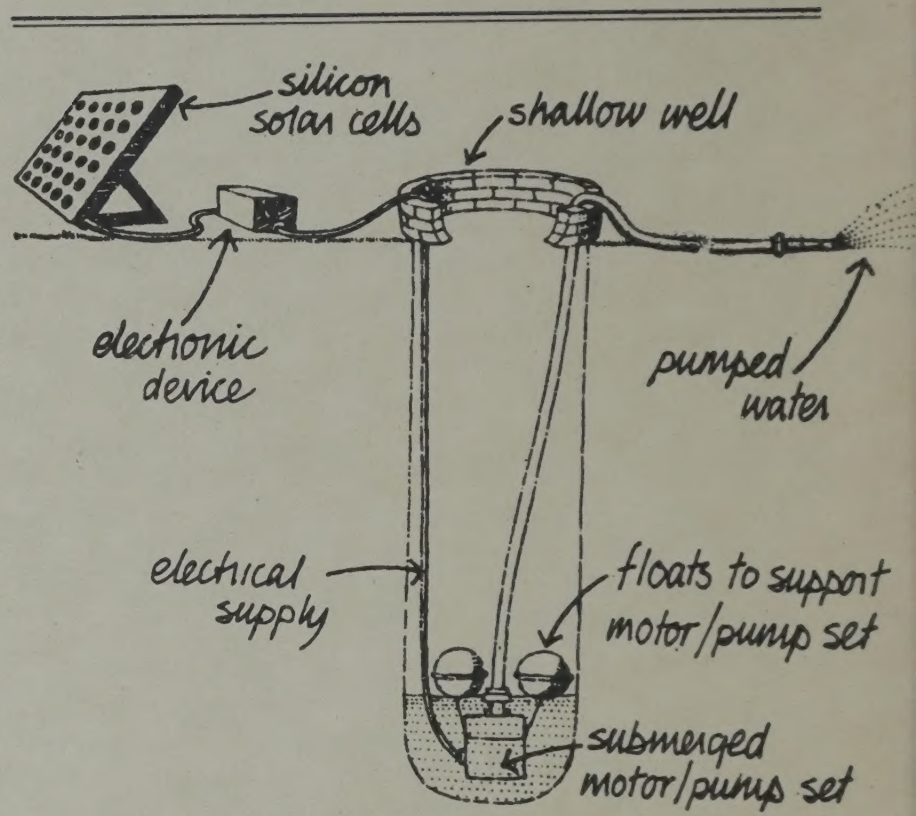
Besides the traditional and modern fuels, alternative fuels are also being developed. These *non-conventional* sources of energy are renewable and non-polluting. The most important of these is *solar* power. We use the energy of the sun when we put out wet clothes to dry in the sunshine. Similarly, specially developed solar panels concentrate the rays of the sun to produce heat for cooking or boiling water. Solar cookers and water heaters have been manufactured and these are being used in various places from village homes to large hotels. These solar devices are, however, still too expensive to replace the traditional stoves and boilers.

Among the non-conventional energy sources, *biogas* is particularly useful for village households which have their own cattle. Through a simple system, cattle dung is used to produce a gas that serves as fuel for cooking and lighting. The residue or slurry can be put back into the field as manure. Bacteria decomposes the dung to release the gas. The bacteria require a certain minimum outside temperature; otherwise they cease to be active. This makes it a little difficult to produce biogas in the winter months.

Planting trees for firewood is another non-conventional source, which uses plant energy or *biomass energy*. This can also help to ease the pressure on natural forests.

Energy from the wind, as in windmills, from ocean waves and from the heat of the earth are other non-conventional sources of power.

Although the technology for non-conventional energy production exists, these alternative sources do not yet produce sufficient energy to replace the huge amounts of energy that most countries get from the conventional sources. In the meantime, there are three things we need to do : we have to use our traditional fuel sources carefully; we have to conserve our fossil fuels because they will not last for ever; and we have to focus much more attention on developing efficient renewable



energy devices which can work using cleaner, alternate sources. In India, research in this directrion is still in the preliminary stages and needs to be emphasised much more.

Activity 10

Work-Horse

I was now four years old and I had grown into a handsome horse. I was to be "broken in". I did not understand what this meant but I came to know later what a painful process this was. First I was to have a bit and bridle.My master coaxed me with oats and kind words and then got the bit into my mouth and fixed the bridle. What a nasty experience that was ! Only horses will know. A great piece of harsh steel was pushed into my mouth between my teeth and over my tongue with the end coming out of the corners of my mouth and it was held fast there by straps all over. It was very bad indeed ! But I knew that my mother wore one and I bore all the discomfort because of the kindness of my master.

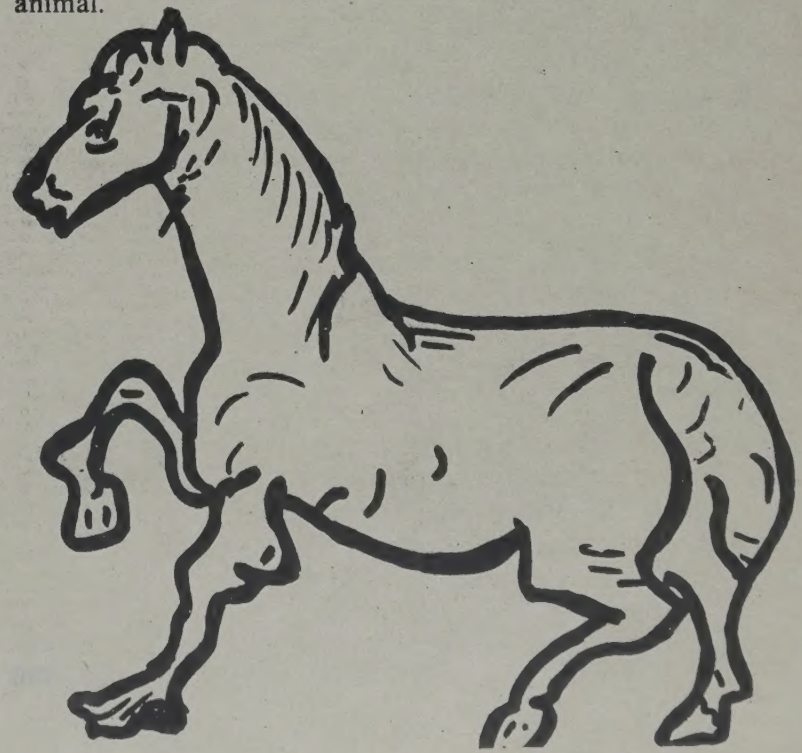
Next I had to wear the saddle but it was not half as uncomfortable. My master put it on me gently and made the girths fast under my body.

Then I had to put on iron shoes. I assure you that it was rather unpleasant. The blacksmith took my feet, one at a time, cut off some of the hoof and then nailed an iron shoe into it. I felt rather stiff and heavy in my feet but I got used to it in course of time.

Having got so far, my master went on to break me to harness. He put a stiff heavy collar on my neck and a bridle with blinkers against my eyes. With blinkers on I could only see straight in front of me and that made me feel very nervous indeed. Then he put a small saddle on me with a stiff strap that went under my tail. I heated this strap so much that I felt like kicking but how could I kick such a good master ! Slowly I got used to these and was able to do my work as well as my mother did.

—Anna Sewell.

Read this passage. Then draw or write the life story of the animal.



Activity 2

Firewood for the Poor

In rural areas, fuelwood cutting is rarely the cause of large-scale deforestation. But as forests recede, pressure on the remaining trees grows. Over time, fuelwood scarcities can develop, with fuelwood cutting becoming a major factor in the devegetation of the countryside.

People living near forest reserves may gather their wood in them, legally or illegally. But most of the firewood villagers burn comes from trees outside designated forests. These trees, dotted around the farming landscape, provide building poles and animal fodder as well as fuel. They are also sources of fruits, herbs, medicines, fibres, leaves and fungi. Though wealthier rural people may be able to afford modern alternatives, the poor often rely on trees for a whole array of daily needs.

Where local population densities remain low, the demand for fuelwood can usually be met without damaging the local standing stock of trees. By travelling short distances from their homes people are able to gather sufficient wood without damaging the resource base. People who own land may be able to make do from their own trees. Where shifting cultivation is practised, clearing trees from fallow land will often yield more than enough wood for domestic uses.

Where fuelwood is plentiful, usually only dead wood is collected. It is lighter to carry than green wood, it is easier to cut and it burns better. Though branches may be lopped off, whole trees are rarely felled merely to provide fuel.

As rural populations grow, the increase in fuelwood demand is usually met first by extending the collection area. People search longer and farther to obtain good quality fuelwood. But provided there are enough trees in this wider area, supply and demand can remain roughly in balance; the cost is in terms of productive time, usually women's.

Eventually, people will not be able to find new sources of wood within walking distance. It is then that fuelwood cutting can start to cause deforestation, as fuelwood demands begin to eat into the remaining standing stock of trees. At this point people begin turning to lower quality wood, roots, crop residues, dung and other combustible materials.

—Erik Eckholm et al.

Fuelwood—the Energy Crisis that Won't Go Away
Easthscan, London

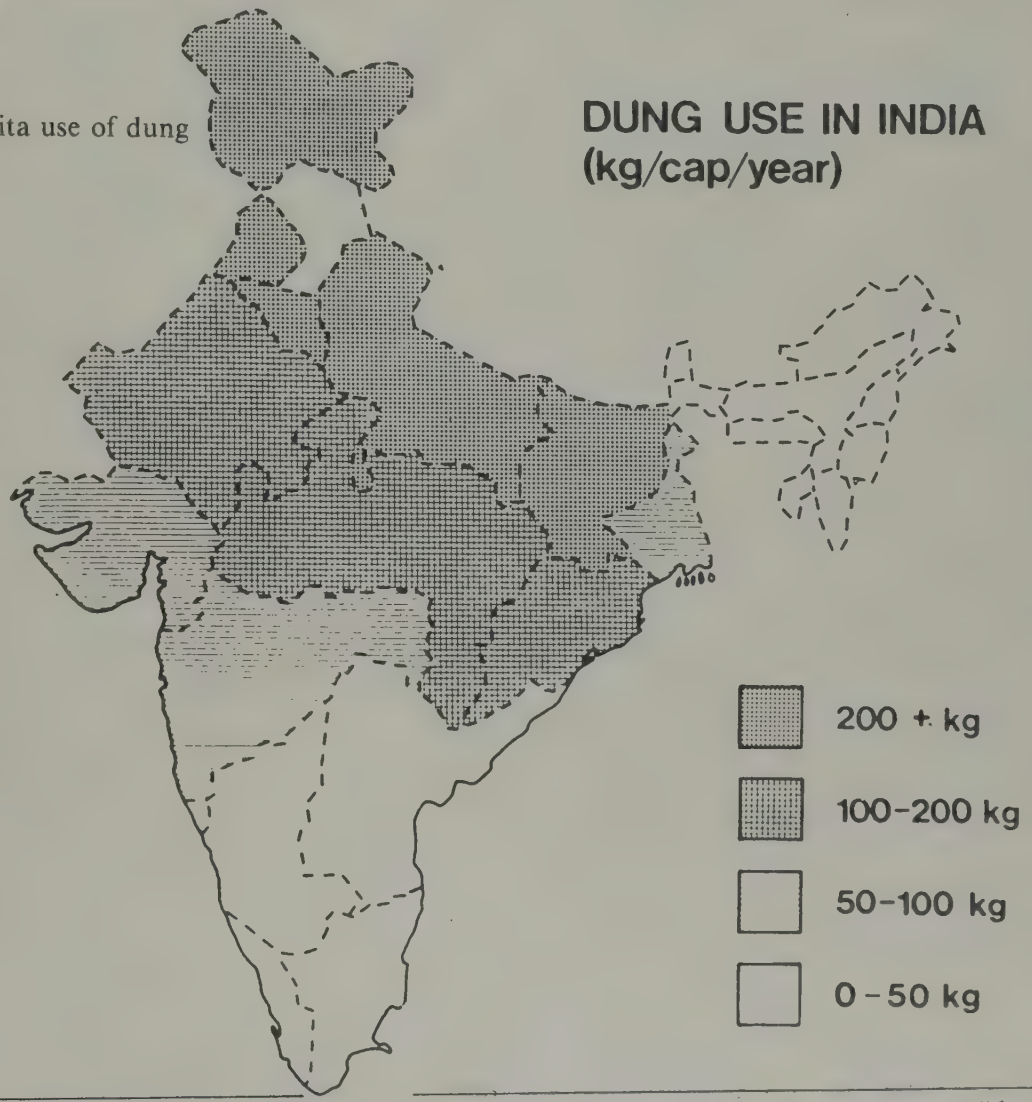
Read this passage. Then have a discussion or debate on the subject : "People are short of firewood because they are poor".

Help children to understand that for the really poor, the depletion of formerly free supplies of firewood means that fuel joins food, water and housing, as the basic needs which are inadequately satisfied.

Activity 3

Burning Dung

The map shows the daily per capita use of dung in different states.



Modernisers often refer to the "dung culture" of Indian Villages. This dung, however, was not so much sacred as it was simply the cheapest and most easily available natural resource which had a variety of everyday uses. It was used to wash the floor — because it has the quality of a natural disinfectant. It was gathered as a manure for our vegetables — direct evidence of what is now fashionably called "recycling". Dung was dried and used for fuel. The peasants used it to stop leaks in their thatched huts.

Find out who uses dung and for what purposes. Talk to the elders in your own family. Was dung used in their homes when they were young?

Read Unit 3.11 again. Do you think the phrase "dung culture" describes Indian villages aptly?

Activity 4

Read A Meter

Electric meters measure electrical energy in units — one unit is the equivalent of using 1 kilowatt per hour. Look at the electric meter in your school or home. The wheel of the meter rotates when electricity is consumed, that is, when fans or lights are turned on. The meter stops rotating when all the fans, lights and other electrical gadgets are turned off. The more the electricity consumed, the faster the wheel turns. Each turn of the wheel is recorded by the changing numbers.

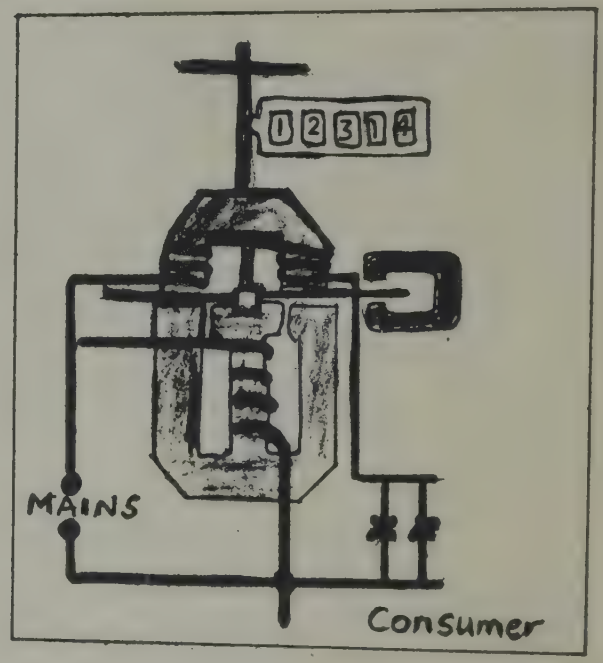
Make a meter reading table. Then note the numbers, the first thing on Monday morning. This is your first meter reading. Enter it on the table. A week later, the next Monday morning, note the numbers again. The difference is the number of units consumed that week.

	Date	time	Meter Reading	Units consumed
Start				
Week 1.				
Week 2.				

If you like, you can make observations every week for a month. You can then calculate how many units are used over that period.

Find out the price of a unit of electricity in your area. Then calculate the price of the electricity that has been consumed. Think of ways in which you can help reduce the amount of electricity used at school, or in your home.

Encourage children to find out the source of their electricity supply - and whether it is thermal, hydroelectric etc., or a combination of different sources.



Activity 5

Oil Quiz

1. From where do we get crude oil ? Tick the right answer.

a) From living plants ☐
b) From under the earth ☐
c) From coal ☐

2. Petrol is produced from crude oil. Can you tick off the other products that are also produced from crude oil ?

a) Cooking gas ☐
b) Fire crackers ☐
c) Plastics ☐
d) Paper ☐
e) Kerosene ☐
f) Paints ☐

3. It is very important to conserve or save oil because — (tick one)

a) Oil is a dangerous substance. ☐
b) Our scientists want to find new uses for it. ☐
c) Oil isn't going to last forever, and we must use it without wasting it. ☐

4. There is waste of fuel in some of the following. Can you tick them off ?

a) A car with black smoke coming out. ☐
b) A truck driven slowly and steadily ☐
c) A man cycling to the market instead of using his car. ☐
d) A van being loaded while the engine is running ☐

5. Are these statements true or false ?

a) India does not have enough of its own crude oil. TRUE/FALSE

b) There is an unlimited supply of crude oil under the earth. TRUE/FALSE

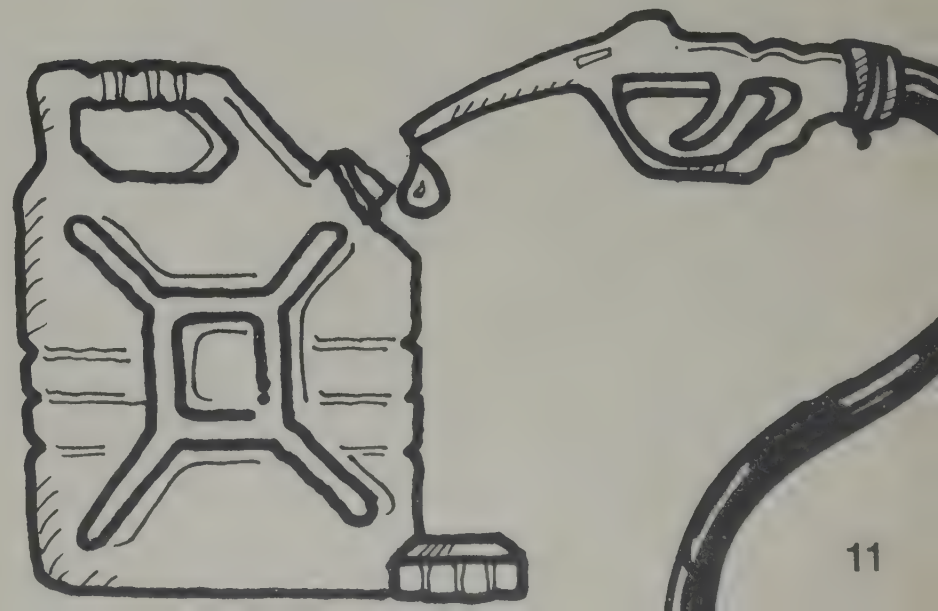
c) Crude oil is sometimes found under the ocean bed. TRUE/FALSE

Make up an Oil Quiz or Coal Quiz and try it with your friends.

Read : *Mickey Mouse and Goofy Explore Energy*,
Petroleum Consevation Research Association.
1008, New Delhi House,
27, Barakhamba Road, New Delhi-110 001.

Distinguish between fuel oil got from refined crude oil — and cooking oil got from plant seeds.

Ans. 1 *b)* 2 *a) c) e) f)* 3 *c)* 4 *a) d)* 5 *a) TRUE. b) FALSE. c) TRUE.*



Activity

Self-help in Khandia

Khandia, a village of about 1,000 people, is typical of thousands of Gujarat villages. It is about 45 kms south of Baroda, far from the nearest tarred road, and seldom visited by doctors, social workers, agricultural experts or forest officials. The village fields, 186 hectares in all, are poorly irrigated and infertile. Rice, wheat, millet and cotton crops are grown. The women cook on open hearths, scrambling for firewood and collecting cow dung. Most villagers used to suffer from lung trouble. There was little work available.

Then in 1983, the Gujarat Energy Development Agency, a non-government organisation, chose Khandia for an experiment on alternative sources of energy. Like most other Indian villages, Khandia needed energy mainly for cooking and for lighting. But firewood was hard to get. So an alternative source was necessary.

The 130 households in Khandia were persuaded to form an energy cooperative. The idea was that they would generate the energy themselves and share it.

First, 12 hectares of wasteland were planted with fast-growing trees like neem, tamarind and eucalyptus. The 250 tonnes of wood that would be produced by this energy plantation, plus waste materials, will be used to create *producer-gas*. This will feed a *gasifier engine* which, in turn, will power a generator. The generator will produce 25 kilowatts of power for street lighting, two light points in each house, pumps for the community water supply, the village flour mill and other small local industries. Four smaller gasifier-run pumps will draw water and distribute it through irrigation channels to 70 hectares of farm land.

As a second source of energy, an 85 cubic meter *community biogas* plant was set up. Each villager who wanted to use the gas for cooking would have to sell a basketful of *gobar* (dung) or agricultural waste every day to the community plant. The biogas plant supplied gas twice a day through pipes to household gas stoves.

The third alternative source of energy in Khandia is solar energy. Khandia now has a health centre with a refrigerator for keeping vaccines and medicine—it is run on energy got from *photovoltaic cells* which concentrate the sun's energy. It also has a 250 litre hot water system and a solar still to make distilled (or pure) water. Khandia also now has a community centre with solar-powered television and radio sets.

The cost of setting up this whole energy system was Rs.1,875 per person. It seems like a lot for a poor village, but it is less than what it would cost to bring electricity from far away by power lines to the village. The Gujarat Energy Development Agency believes that if one quarter of one percent of India's national budget for electric power during 1985-90 was set aside, this would be enough money to set up alternative energy systems in 1,000 villages like Khandia.

—adapted from S. Muthiah/ Gemini News

Discuss the pros and cons of various alternate sources of energy as compared to conventional sources. Encourage children to find out if there is a biogas plant or solar device operating near your school. Organise a visit to the site. Talk to the people who are using it.

Discuss the concept of self-help. What is the advantage of producing your own energy rather than getting it from afar?

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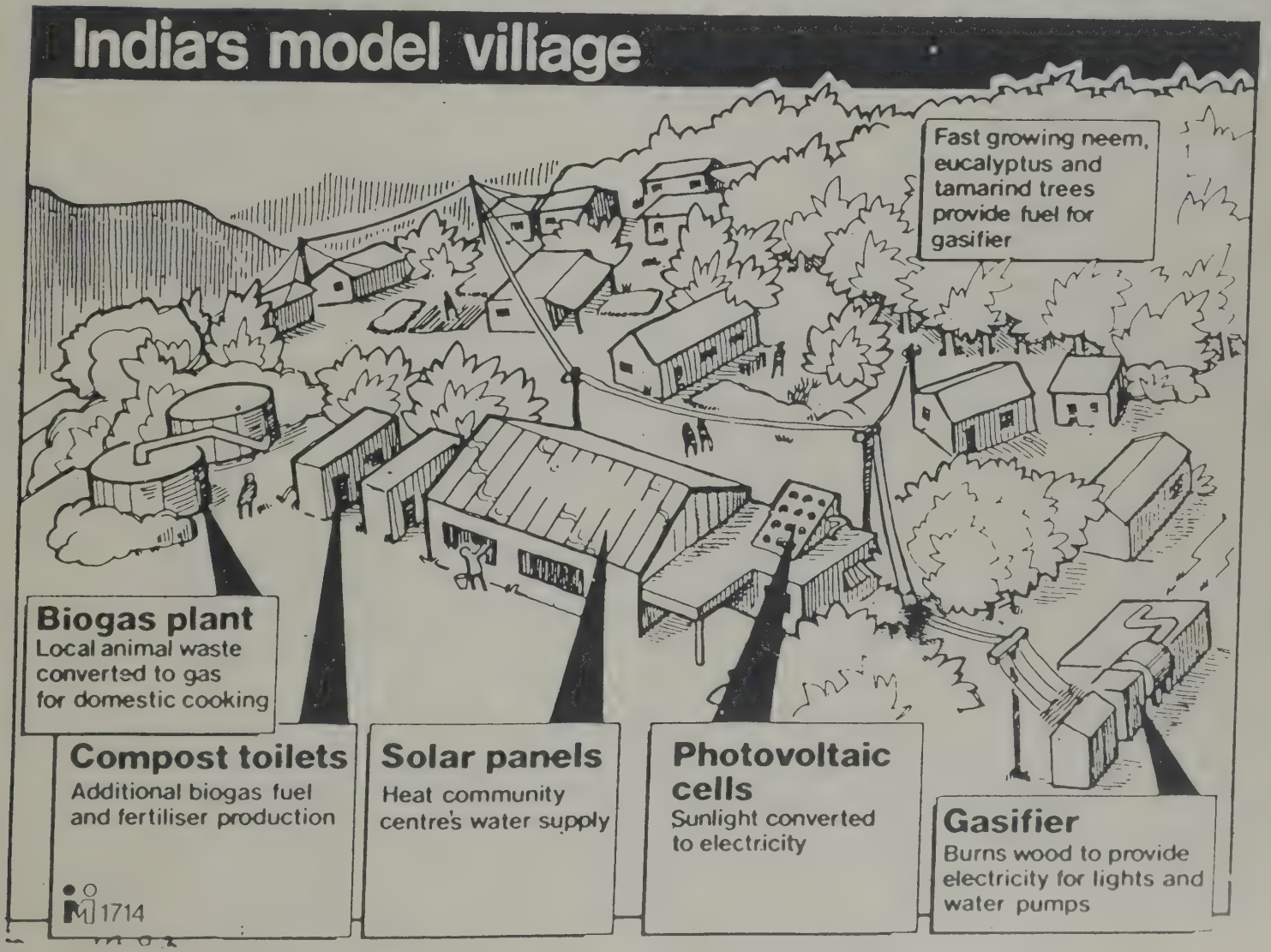
India's model village
Fast growing neem, eucalyptus and tamarind trees provide fuel for gasifier
Biogas plant
Local animal waste converted to gas for domestic cooking
Compost toilets
Additional biogas fuel and fertiliser production
Solar panels
Heat community centre's water supply
Photovoltaic cells
Sunlight converted to electricity
Gasifier
Burns wood to provide electricity for lights and water pumps
1714

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Activity 7

Devices : Old and New

Gasifiers, which convert wood, charcoal and other "biomass" to a combustible gas, kept a million vehicles on Europe's roads during World War-II. Among the various technologies based on biomass, gasification is promising because it can help conserve diesel and save foreign exchange. This is a reliable and convenient technology to energise small engine-driven irrigation pumpsets in the 5-10 horsepower range, which are commonly used in India to irrigate small farms.

Solar energy can be harnessed cheaply by *passive collectors,* such as flat plate collectors used for heating water in homes and hotels, or the *trombe wall* which traps air between a plate of glass and blackened wall, so that the air is warmed by the sun and can be used to heat houses as in Ladakh.

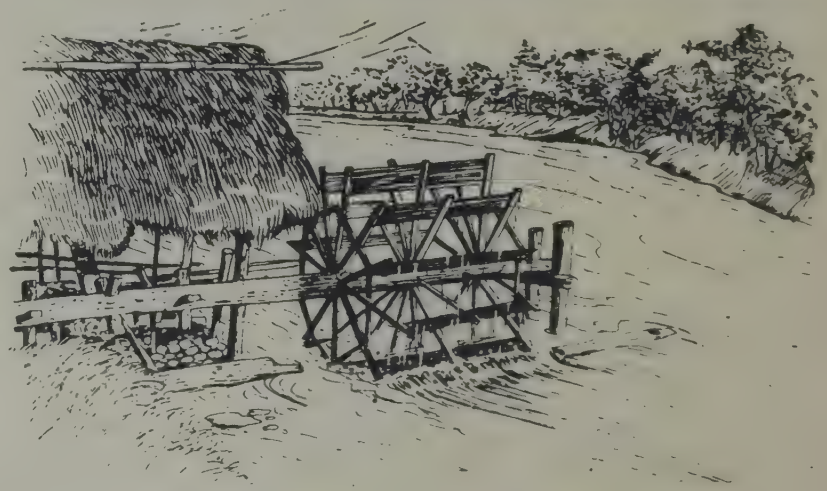
More advanced active devices like *parabolic reflectors* focus sunlight on a water pipe producing intense heat within the pipe, which can then be used for central heating or to produce electricity.

Photovoltaic devices such as the solar cell use two thin semiconductors like silicon which act like a battery in the presence of sunlight. This has tremendous potential, but the production of semi-conductors is expensive and energy-consuming.

From very early times *pan chakkis* in India used small hydropower to grind wheat. These mountain watermills are an example of *microhydel power* at work. Hydropower is one of the best, cheapest and cleanest, sources of renewable energy, although there are many environmental and social problems in the case of large dams. Small hydroelectric plants, however, are free from these problems. Today, we have nearly 90 small hydropower stations in the country, and about 250 more projects are being investigated. The northeastern region especially has great potential for the development of microhydel power.

The ocean is a vast source of potential energy — in waves, tides and the temperature difference between the cold deep waters and the warm surface waters. India is already experimenting with ocean energy — a tidal power project in Kutch, Gujarat; an ocean wave energy project at Kovalam, in Kerala; and an Ocean Thermal Energy Conversion project in Lakshadweep. At present, however, the cost of electricity generated from such sources is likely to be too high.

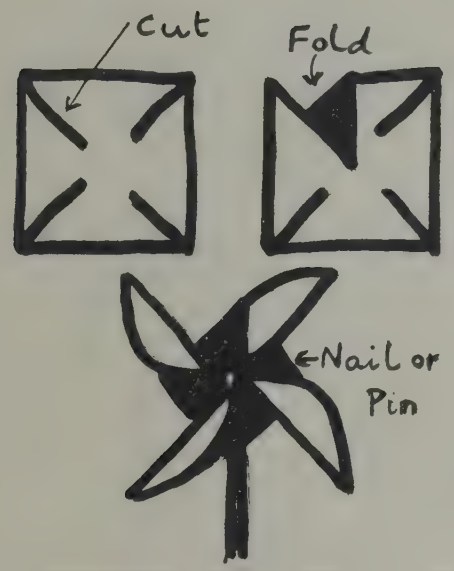
Collect information on renewable energy technologies. You can refer to a book such as *Renewable Energy : Environment and Development* by Maheshwar Dayal (Konarak Publishers)



A Khampti water-wheel which husks paddy. Other wheels, of a different pattern, housed in small stone buildings, for grinding grain or turning prayer-wheels, are made by the Monpas and Sherdukpens of Kameng and the Membas of the Mechuka Valley. — **Verrier Elwin**

Activity 8

Pin Down the Wind



Make a pin wheel, using a piece of stiff paper, thin card board or even the bottom of an old tin. Cut out a circle of cardboard, and make four or six even cuts from the circumference towards the centre. Be careful to keep the centre intact. Bend a part of each segment at an angle. All the bends should be in the same direction.

Now put a wire or pin through the centre and mount your wheel on a smooth stick. Hold it in the wind for the wheel to rotate.

Think of other devices that use the energy of the wind or water to make something move.

Encourage children to think of new devices. Let them use their imagination to invent a water or wind energy device. They can either draw it in detail, or make a small model. Never mind if it does not work very well. Discuss what the problem is with the drawing or the model, and how it could be improved. Discuss the benefits and disadvantages of these energy sources.

Activity

Help the Cook !

Fuel is wasted when :

* *A gas/stove/chula is left burning while vegetables are being cleaned, rice is being washed, dough is being kneaded.*
  Necessary preparations should be made and utensils, masala and other required ingredients must be kept handy before the flame is lit.
* *More than the required quantity of water is used for cooking.*
  Higher temperatures can be reached faster if only sufficient amount of water is used, as also smaller vessels-selecting an appropriate size of the utensils to match the quantity of the food to be cooked.
* *Steam is allowed to escape.*
  Surface evaporation has to be suppressed to reduce heat loss. Covering the utensils with a lid speeds up the cooking process as it holds the steam in it, increasing vapour pressure and also preventing heat loss to the surroundings. Steam cookers and pressure cookers are based on this principle and may need half the fuel or even less for cooking.
* *Cooking continuously on a high flame.*
  A high flame can be used till the water boils. But after the boiling point has been reached the flame must be reduced to a minimum, as this is enough to keep the water simmering until the cooking process is over. This can save as much as 40% fuel.
* *Food is overcooked or overboiled.*
  Not only is fuel wasted, even the nutritional value of the food is reduced.

Fuel consumption can also be reduced by :

* *Soaking rice, dal and pulses.*
  Soaking softens the food grains. Due to osmosis, water enters the grains and softens them. At this stage, the grains are almost half cooked. It would therefore take much less time for cooking soaked grains as compared to unsoaked ones.
* *Blackening the bottom of cooking pans.*
  For maximum absorption of heat it is advisable to blacken the bottom of the shining metallic utensils. A black surface absorbs the heat most efficiently. This fact is unwittingly utilized by several housewives especially in the rural areas.

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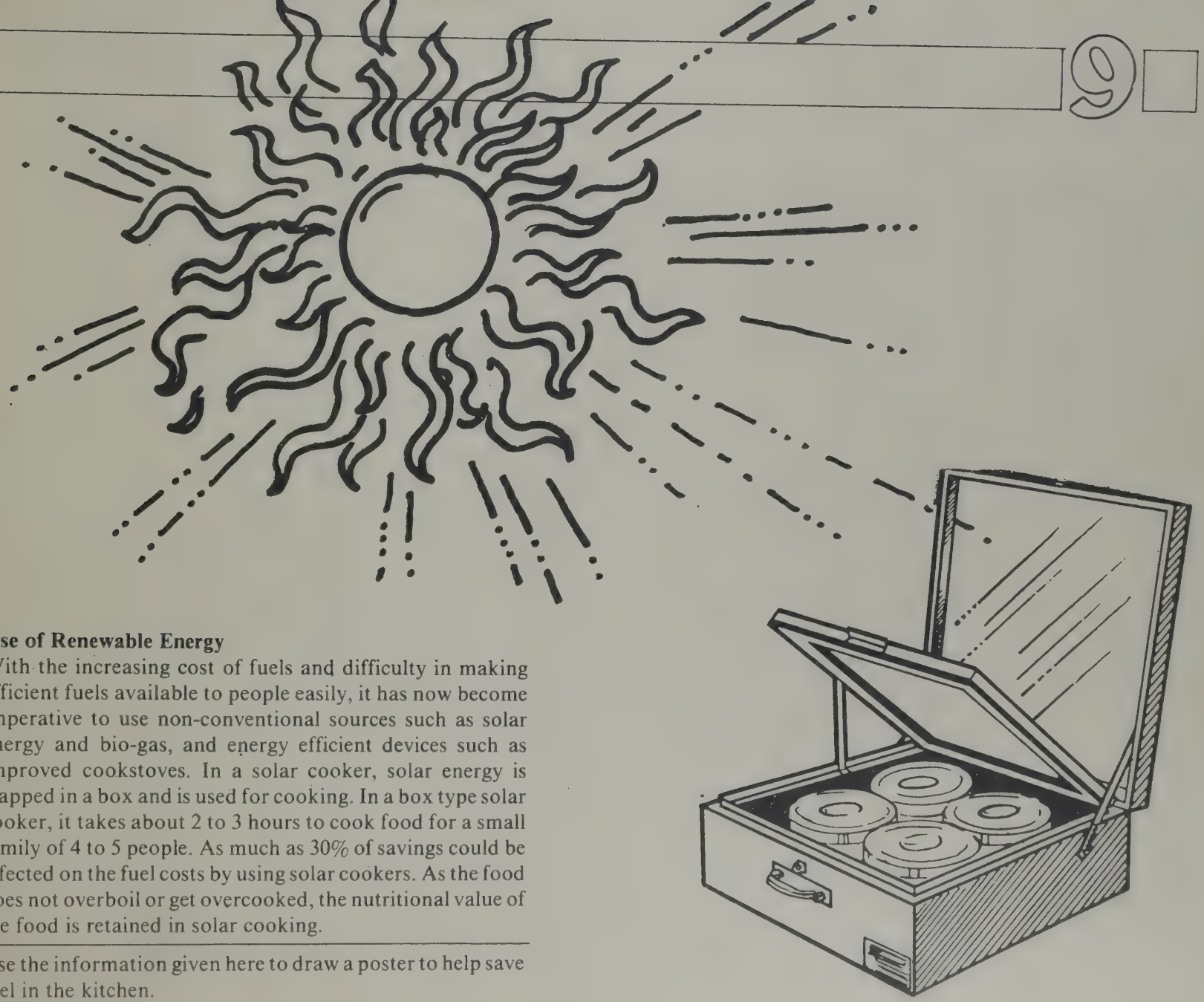
Gujarat Energy Development Agency



Use of Renewable Energy

With the increasing cost of fuels and difficulty in making efficient fuels available to people easily, it has now become imperative to use non-conventional sources such as solar energy and bio-gas, and energy efficient devices such as improved cookstoves. In a solar cooker, solar energy is trapped in a box and is used for cooking. In a box type solar cooker, it takes about 2 to 3 hours to cook food for a small family of 4 to 5 people. As much as 30% of savings could be effected on the fuel costs by using solar cookers. As the food does not overboil or get overcooked, the nutritional value of the food is retained in solar cooking.

Use the information given here to draw a poster to help save fuel in the kitchen.

Activity 10

The Cost of a Hot Bath

What does a hot bath cost ? Not just in terms of the price of the fuel used to heat the water, but in terms of its impact on the environment ? Here is a chart which shows the steps to a hot bath from different energy sources. Suppose you used water heated on a Liquid Petroleum Gas stove, or a solar water heater. What would the steps be like ? Add to this chart, or make up your own for a different activity.

	Nuclear	Coal	Hydro
Mining	✓	✓	
Land reclamation		✓	
Transportation	✓	✓	
Generating	✓	✓	✓
Transmission	✓	✓	✓
Hot Bath	✓	✓	✓
Waste and Pollution	✓	✓	

Adapted from the Gujarat Energy Development Agency

Activity 11

Project Energy

Make groups and let each group select one form of energy. Prepare group projects on the different forms of energy, including the characteristics and uses of each form. Make sure that every form of energy is covered. Display the projects and with the help of the displays fill an energy grid.

Forms of energy

Human
Animal
Sun
Water
Wind
Plants
Coal
Oil
Gas
Nuclear fuel

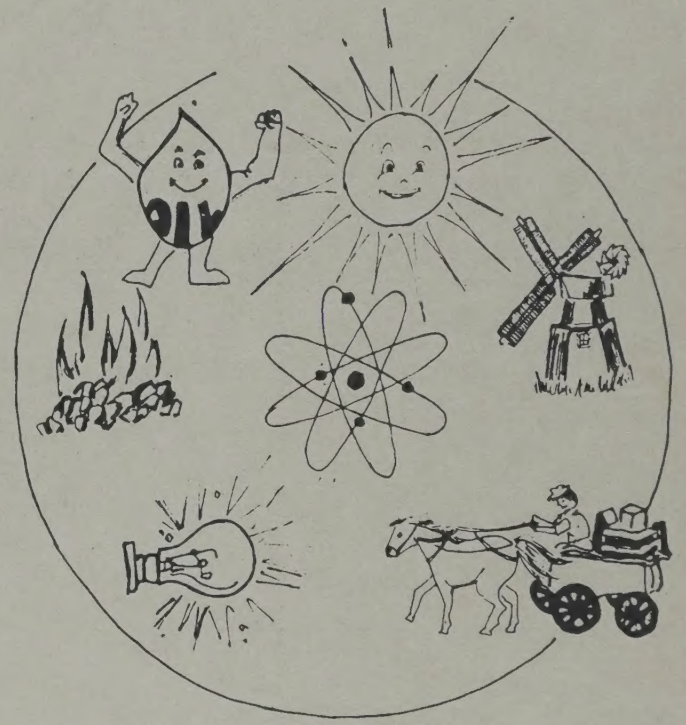
Uses

Transport
Agriculture
Industry
Domestic
Community

Characteristics

Efficiency
Convenience
Safety
Availability
Cost : high
Cost : low
Labour intensive
Capital intensive
Renewable
Polluting
Controlled by outside body
Controlled by community
Benefits economy
Benefits people

Change the grid if you wish. You could include electricity separately or combine water and wind, oil and gas. You could also add to the characteristics, or divide them into positive and negative characteristics.



Make sure that children distinguish between coal (a fossil fuel) and charcoal (a plant fuel).
While making your display consider :
What are the non-renewable energy sources ?
What are the renewable sources ?
Discuss the pros and cons of the non-renewable vs. renewable sources. You can have a class debate on this. Try and put in the experience of other countries which have tried out various sources of energy.

Activity 12

Of Bicycles and Hot Air Balloons

Human beings have always been fascinated by flying. But it was not till the 18th century that men succeeded in floating up into the air in a hot air balloon. Today, aeroplanes have shrunk the world, and made it easy to reach anywhere on earth in a few hours. Rockets and satellites have made travel into outer space possible. However, modern means of transportation, whether by air, sea or land, consume huge amounts of energy — especially scarce petroleum fuel. In India, the transportation of goods by trucks, consumes a major share of the total petroleum that we use.

Read Jules Verne's famous book *Around the World in Eighty Days*. Think about the energy it would take to make one round trip of the earth, today. Of course, your mode of transportation would depend on how fast you wanted to travel, and what you wanted to carry with you. Suppose you were to go around the world on a bicycle, or a hot air balloon,how much energy would you use ?

Do a class project on transport, concentrating on the kind and amount of energy required. Identify the purposes for which different forms of transport may be most suitable, and think of ways to improve the use of forms that consume less energy. For instance, how can the use of bicycles be increased ?

SUBJECT WISE KEY TO ACTIVITIES

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RETURN DATE SLIP

DUE DATE	DUE DATE	DUE DATE

ACTIVITY NUMBERS

SCIENCE	HISTORY	CIVICS	GEO-GRAPHY	MATHS	GAMES & QUIZ	SPECIAL PROJECTS
5,7,8,10			1,3,4,5		8	10
1,2,3,4, 5,6,7,8, 9,10,11			12	9	3,5,8,9	12
3,4,5,6, 7,7a	5	3	2,4,5,6 8,9,10,11		2,10	12
3,4,5,8 10	4,12	6,7,9,10	6,7	5	11	
2,3,5,7 9,10,12		11			5	12
6,7,2	1,4,9,10	3,5,8 10,11,12	1,9	3,8	12	11
3,4,5,6 10,11		2		4	4	11,12
5,6,8,9 10,11,12		3,5,6	4	9	8,12	

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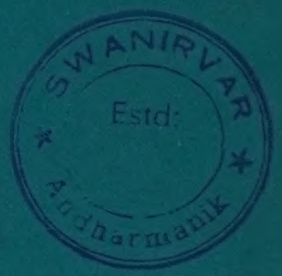
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